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USE OF A FATTY ACID COMPOSITION COMPRISING AT LEAST ONE OF EPA AND DHA OR ANY COMBINATIONS THEREOF

Technical field of the invention

The present invention comprises a number of aspects. According to the first aspect of the present invention, a use of a new medical product for controlling body weight reduction, for treatment of obesity or an overweight condition is disclosed. According to a second aspect of the present invention, a method for treatment of obesity, an overweight condition or for controlling body weight reduction, is disclosed. According to a third aspect of the invention, a use of a food stuff or food supplement for controlling and supporting body weight reduction in a human or an animal, is disclosed. Moreover, according to a fourth aspect of the present invention, a dietary product for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling weight reduction, is disclosed. Additionally, according to a fifth aspect of the present invention, a use of a dietary food stuff or food supplement for controlling and supporting weight reduction, is disclosed. Finally, according to the sixth aspect of the present invention, a method for supplementing a dietary food stuff, is disclosed. The aspects above are based on at least one of the following features: a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, or a step of adding a fatty

acid composition comprising at least one of EPA and DHA or any combinations thereof, to a supplement product.

Background art

More individuals are becoming overweight and obese, a condition now considered to be the most common nutritional disorder in the industrialised world today. Overweight and obesity can be defined by a body-mass index exceeding 25 or 30. Normal values range from 18 to 25. In the US 34% of the population is overweight and another 27% is obese. This means that more than 60% of the entire population in the US has what can be defined as having a weight problem, which is likely to cause severe health problems, such as hypertension and elevated blood lipids, all risk factors for cardiovascular disease.

Overweight and obesity are caused by an imbalance between energy intake and energy use. In the industrialised world we tend to eat too much and engage in physical activities too little. However, the likelihood of becoming fat under these conditions is not the same for everyone, as witnessed by the fact that slim individuals exist under the same conditions as those who are overweight. Furthermore, the revelation that nutritional factors may control gene expression has opened up the possibility of developing novel therapeutic alternatives to treat obesity. The major problem in therapeutic strategies aimed to treat obesity and decrease body fat deposit is that such strategies act against potent and multiple mechanisms evolved in order to store metabolic energy and support survival under the periods when nutrition is scarce.

Once stored in adipose tissue, the metabolic energy is only released under the conditions of negative energy balance, namely during fasting and/or physical exercise. Importantly, the loss of the energy content of the tissue under these conditions results from both, increased secretion of fatty acids from adipose tissue cells, and catabolism of tissue lipids, which increases during fasting (Wang T et al., Obesity Research 11:880-887, 2003).

Fats are composed of fatty acids and fat is the most calorie dense nutrient. High fat diets are linked to excess weight gain, but not all fats are equal. In the gastrointestinal tract fats are broken down into fatty acids by lipases and absorbed into the intestinal cells. In intestinal cells, the lymphatic system and the liver, fatty complexes are produced to transport fatty acids. In the circulation these fatty acids are released by lipases entering cells or getting integrated into the cell membranes. Most fatty acids are used for energy, but some, especially polyunsaturated fatty acids have other functions including interacting with cellular proteins, which in turn enter the nucleus and turn genes off and on. These genes are known to encode proteins important in controlling energy production from glucose and fat.

Fatty acids differ in their three-dimensional structure, which is determined by the chain-length of the molecule and the number of double bonds present. The most common dietary fats are medium to long chains fatty acids. Saturated fatty acids have no double bonds, resulting in a straight molecule. If a double bond is present then an angle of 120 degrees is produced. Thus, polyunsaturated fatty acids (PUFA's) have a completely different spatial resolution when compared to the

saturated fatty acids. The differences in three dimensional structure between fatty acids means that while the PUFA's can act as signalling agents to the cell, switching gene transcription off or on, the saturated fatty acids are not recognised and have no effect. In the laboratory calorimeter all fats irrespective of their saturated or unsaturated nature generate 9 kcal of energy per gram, but when part of the diet, PUFA's give completely different net effects on metabolic energy production and weight gain compared to the saturated fatty acids. Thus, saturated fatty acids are the main source of energy in the human body, while PUFAs fulfil a different function. PUFA's are derived mainly from seeds, nuts or fish oil. They may have their first double bond located either three, six or nine carbon atoms away from the chain end. Thus, they are known either as omega-3, omega-6 and omega-9 fatty acids, or n-3, n-6 and n-9 fatty acids. Humans can not synthesise fatty acids with double bonds at the 3 or 6 location making these fatty acids essential dietary components. In certain cases both types of PUFA's may have the same action. One example is the effects of PUFA's on suppressing lipid synthesis in the liver while at the same time up-regulating fatty acid oxidation in the liver and skeletal muscle. It has also been demonstrated that PUFA's decrease the transcription of hepatic genes encoding glycolytic and lipogenic enzymes. The effect of the PUFA's on gene expression in the liver and muscle thus leads to increased metabolism and decreased fat storage, helping to prevent weight gain. Energy conversion is mainly located to the mitochondria within the cell. The mitochondria preferentially oxidise medium- and short-chain fatty acids. Energy released is

converted into ATP, which is used for a large number of energy dependent processes. However, mitochondrial energy conversion is not 100% efficient, and part of the metabolic energy is released as heat. The efficiency of mitochondrial energy conversion is modulated by mitochondrial uncoupling proteins. Further, the PUFA's also affect another site for metabolic energy conversion, namely the peroxisome also located inside the cell membrane. While the main role of mitochondria is the production of the energy-rich ATP, peroxisomes are more active in the generation of heat, while shortening polyunsaturated long-chain fatty acids before their further oxidation in mitochondria. The net effect is increased production of heat instead of increasing the fat deposits. PUFA's are peroxisome proliferators increasing the amount and the activity of peroxisomes.

Moreover, during fasting, a major physiological situation leding to the depression of adiposity, energy content of fat cells may be reduced by several mechanisms, like upregulation of mitochondrial uncoupling protein 2, see (Millet L et al. J. Clin. Invest. 100:2665-2670, 1997; Vidal-Puig A. et al. Obesity Research 7:133-140, 1999). Moreover, it has been shown that reduction of abdominal fat by dietary omega-3 PUFAs in rats is associated with increased levels of expression of uncoupling proteins 2 and 3 in adipose tissue (Oudart H. et al. Int. J. Obesity and Metab. Disord. 24 Supp 1:S130, 2000; Hun C.S. et al. Biochem. Biophys. Res. Commun. 259:85-90, 1999). Furthermore, it has also been shown that a 6 g/day substitution of visible fat by fish oil in healthy adults reduces fat mass and increases basal lipid oxidation (Couet C, Delarue J, Ritz P, Antoine J-M and Lamisse F, 1997, International Journal of

Obesity 21: 637-643), but at the same time the fish oil had no significant effect on body weight reduction.

Summary of the invention

Based on the present invention a number of aspects are presented in the appended claims. These aspects are;

1. Use of a new medical product for controlling body weight reduction, for treatment of obesity or an overweight condition.
2. A method for treatment of obesity, an overweight condition or for controlling body weight reduction.
3. Use of a food stuff or food supplement for controlling and supporting body weight reduction in a human or an animal.
4. A dietary product for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling weight reduction.
5. Use of a dietary food stuff or food supplement for controlling and supporting weight reduction.
6. A method for supplementing a dietary food stuff.

The aspects above are based on at lest one of the following features:

- a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof.
- a step of adding a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic

acid (DHA) or any combinations thereof, to the supplement product.

According to a first aspect of the invention, the invention relates to the use of a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for the production of a medicinal product for controlling body weight reduction, for treatment of obesity or an overweight condition. From research leading to the invention it was surprisingly found that a fatty acid composition according to the invention leads to body weight reduction in mice.

In a preferred embodiment, the invention relates to the use of a fatty acid composition comprising (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or a combination of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA), wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1, for the production of a medicinal product for controlling body weight reduction, treatment of obesity or an overweight condition. Please note that X being one of an integer or non-integer.

Moreover, from the research leading to the invention it was found that the most preferred effect of the invention concerning weight reduction is accomplished by a fatty acid composition rich in DHA. The term "rich" herein includes more or less a fatty acid composition primary containing DHA (none EPA) and a fatty acid composition there the amount of DHA ≥ EPA. Further, the

term "amount" herein relates to weight or volume of the fatty acid composition. Moreover, the desired pharmacological and/or therapeutic effect may be achieved by the fatty acid composition according to the invention.

In addition, as known before food reduction alone will not effectively lead to weight reduction in a human. Suitably, the treatment according to the invention is combined with at least one of calorie restriction, (fasting), dietary and physical exercise or combinations thereof, that may lead to body weight reduction in a human or an animal. Furthermore, this opens up for a future market for a pharmaceutical, a food stuff and/or a dietary product containing the fatty acid composition according to the invention not only for the purpose of treating obesity or overweight conditions, but also for the purpose of controlling and supporting body weight reduction (a helping hand for weight control, body weight reduction, preferably in combination with a reduced intake of calories).

In a preferred embodiment of the invention, EPA and DHA in the fatty acid composition are present in the composition in an EPA:DHA ratio from 1:1 to 1:8. In a more preferred embodiment the EPA:DHA ratio in the fatty acid composition is from about 1:1 to 1:6. Moreover, the invention also includes administering a fatty acid composition that is a DHA-product.

In another embodiment, the fatty acids in the composition according to the invention is presented in at least one of esterified form, ethyl ester form, salt form and free acid form, or any combinations thereof. In a preferred embodiment, the fatty acid composition is comprised of a combination of EPA and DHA in triglyceride form.

In another embodiment, at lest one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins or combinations thereof. The invention includes therefore for instance a fatty acid composition comprising at least one of a DHA-containing microbial oil and a mixture of an DHA-containing oil from microbial origin and a EPA-containing oil from a marine origin. Further, the fatty acid composition according to the invention may additionally also comprise at least one of arachidonic acid (ARA), docosapentaenoic acid, heneicosapentaenoic acid and octadecatentraenoic or any combinations thereof. Suitably, at least a part of the EPA and/or DHA is produced from a marine oil, preferably a fish oil. Furthermore, in another embodiment the fatty acid composition is produced from a marine oil, such as a fish oil.

Moreover, it should be pointed out that the fatty acid composition is administered to a human or an animal, preferably orally, in the form of for instance a pill or a soft capsule. However, the medicinal product according to the invention may also be produced for administration though any other route where the active ingredients may be efficiently absorbed and utilized, e.g. intravenously, subcutaneously or intramuscularly.

In a preferred embodiment of the invention the treatment or intake of a medicinal product is carried out together with a reduced intake of calories for a human or an animal. Suitably, the reduced intake of calories is also combined with physical exercise. If the administration of a medicinal product according to the invention, to a human or an animal, goes hand-in-hand with a reduced intake of calories the reduction in body weight will be more effective.

In another preferred embodiment of the invention, the fatty acid composition comprising at least one of EPA and DHA or any combination thereof is administered in a daily dosage in the interval 10-40 % of the total lipid content of a daily diet for a human or an animal. This means that 10 up to 40 % of the total lipid content of a daily diet may be replaced by the fatty acid composition according to the invention. Please note that, another way of defining the daily dosage of the fatty acid composition is presented above.

In another preferred embodiment of the invention, the fatty acid composition comprising DHA or a combination of EPA and DHA is administered in an amount providing a daily dosage of 1 g to 15 g of said fatty acid composition. In a more preferred embodiment between 2 and 10 g of said fatty acid composition is administered per day, and in a most preferred embodiment between 2 and 6 g of said fatty acid (per day). As has been shown in the experiments the effect of the fatty acid composition according to the invention seams to be extra strong at high doses. The medicinal product or pharmaceutical composition or pharmaceutical preparation according to the invention may also comprise other substances such as an inert vehicle, or pharmaceutical acceptable adjuvants, carriers, preservatives etc., which are well known in to those skilled in the art. Additionally, the medicinal product may be administered to an animal such as a pet or a horse.

According to a second aspect of the invention, the invention relates to a method for treatment of obesity, and overweight condition or for controlling body weight reduction, wherein an effective amount of a fatty acid composition comprising at least one of (all-Z omega-3)-

5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or combinations thereof, is administered to a human or an animal. Herein, "an effective amount" also includes a therapeutically or a pharmaceutically active amount of the fatty acid composition. This expression relates to a dose of said fatty acid composition that will lead to the desired pharmacological and/or therapeutic effect. The desired pharmacological and/or therapeutic effect is, as stated above, achieved by the fatty acid composition according to the invention.

In a preferred embodiment of the method, said fatty acid composition comprising DHA or a combination of EPA and DHA, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1. This method leads to the same advantages and possibilities as mentioned before. Thus, the embodiments described above is also included for the method according to the invention concerning treatment of obesity, an overweight condition an/or for controlling and/or reducing body weight. Additionally, in another embodiment of the method according to the invention, with the aim to reduce body weight, said fatty acid composition is administered in a daily dosage that corresponds to at least 10 % of the total lipid content of a daily diet for a human or an animal.

According to a third aspect of the invention, the present invention relates to the use of a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for the production of a food

stuff or food supplement for controlling and supporting body weight reduction.

In a specific embodiment, the present invention relates to the use of a fatty acid composition comprising (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or a combination of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA), wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1, for the production of a food stuff or food supplement for controlling body weight and for supporting weight reduction. The most preferred effect of the invention related to body weight reduction is also there accomplished by the use of DHA or a fatty acid composition rich in DHA, i.e. more DHA in relation to EPA. One advantage of manufacturing and selling a food stuff for at least one of reducing body weight, controlling and supporting body weight reduction is that such a food stuff will be more easily accessible for people. They preferably buy the product or supplement in a health store and/or a supermarket, and they do not need to visit a doctor.

In a preferred embodiment of the invention, EPA and DHA in the fatty acid composition are present in the composition in an EPA:DHA ratio from 1:1 to 1:8. In a more preferred embodiment the EPA:DHA ratio in the fatty acid composition is from about 1:1 to 1:6. In another embodiment of the invention, the fatty acid composition is a DHA-product.

Moreover, in another embodiment, the fatty acids in the composition according to the invention is presented in at least one of esterified form, ethyl ester form,

salt form and free acid form, or any combinations thereof. In a preferred embodiment, the fatty acid composition is comprised of a combination of EPA and DHA in triglyceride form.

In another embodiment, at lest one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins. The food stuff or food supplement includes therefore for instance a fatty acid composition comprising at least one of a DHA-containing microbial oil and a mixture of an DHA-containing oil from microbial origin and a EPA-containing oil from a marine origin. Further, the fatty acid composition according to the invention may additionally also comprise other fatty acids as mentioned before. Suitably, at least a part of the EPA and/or DHA is produced from a marine oil, preferably a fish oil.

Furthermore, in another embodiment of the food stuff or food supplement the fatty acid composition is produced from a marine oil, such as a fish oil. Moreover, it should be pointed out that the fatty acid composition is administered to a human or an animal, preferably orally. However, the food stuff or food supplement according to the invention may also be produced for administration though any other route where the active ingredients may be efficiently absorbed and utilized, e.g. intravenously, subcutaneously, intramuscularly, intranasally, rectally, vaginally or topically.

In a preferred embodiment of the invention, the intake of a food stuff or food supplement is carried out together with a reduced intake of calories for a human or an animal. Herein an animal is a pet or a horse. Suitably, the reduced intake of calories is also combined with physical exercise. If the administration of a food

stuff or food supplement according to the invention, to a human or an animal, goes hand-in-hand with a reduced intake of calories the reduction in body weight will be more effective.

In another preferred embodiment of the invention, said fatty acid composition is administered in a daily dosage in the interval 10-40 % of the total lipid content of a daily diet for a human or an animal. This means that 10 up to 40 % of the total lipid content of a daily diet may be replaced by the fatty acid composition according to the invention.

In another preferred embodiment of the invention, the fatty acid composition comprising DHA or a combination of EPA and DHA is administered in an amount providing a daily dosage of 1 g to 15 g of said fatty acid composition. In a more preferred embodiment between 2 and 10 g of said fatty acid composition is administered per day, and in a most preferred embodiment between 2 and 6 g of said fatty acid (per day). As mentioned before the effect of the fatty acid composition according to the invention seams to be extra strong at high doses.

In another preferred embodiment, the food stuff or food supplement is in form of capsule, preferably a gelatine capsule which capsule is flavoured. This embodiment also includes a capsule, wherein both the capsule and the encapsulated fatty acid composition, preferably a fish oil, is flavoured. By flavouring the capsule as above, the product will become more attractive to the user.

Further, human beings are not designed to lose body weight only during fasting. A sound strategy for losing weight should also take into account measures of energy expenditure and dietary advice based on the individual.

Thus, according to a fourth aspect of the invention, the present invention relates to a dietary product containing a fatty acid composition comprising at least one of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling body weight reduction.

In a preferred embodiment of the invention, the dietary product containing a fatty acid composition comprising (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or a combination of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA), wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1, for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling body weight reduction.

In another embodiment of the invention, the dietary product is a weight-watching product or a slimming product.

In another embodiment according to the dietary product, the combination of EPA and DHA are present in the composition in an EPA:DHA ratio from about 1:1 to 1:8, preferably in an EPA:DHA ratio from 1:1 to 1:6.

In another embodiment of the dietary product, at least one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins or combinations thereof. Preferably, the fatty acid composition is produced from a marine oil, for instance a fish oil. Suitably, the intake of the dietary product is combined with a reduced intake of calories for a human and/or

together with physical activity in order to accelerate and increase the weight reduction effect.

In a preferred embodiment of the dietary product, said fatty acid composition is administered in a daily dosage that corresponds to at least 10 % of the total lipid content of a daily diet for a human or an animal.

According to a fifth aspect of the invention, the present invention relates to the use of a fatty acid composition comprising at least one of EPA and DHA or any combinations thereof, in the manufacture of a dietary product for controlling and supporting weight reduction in a human.

In a preferred embodiment, the use of a fatty acid composition comprising (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or a combination of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA), wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or lager than 1, in the manufacture of a dietary product for controlling body weight and for supporting weight reduction in a human.

According to a sixth aspect of the invention, the invention relates to a method for supplementing a dietary product comprising the step of adding a fatty acid composition comprising at least one of EPA and DHA or any combinations thereof, to a the supplement product for controlling and supporting weight reduction, preferably in a human.

In a preferred embodiment of the method for supplementing a dietary product, the invention relates to the step of adding a fatty acid composition comprising (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid

(DHA) or a combination of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA), wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or lager than 1, to a supplement product, such as a weight-watching product or a slimming product.

Most of the dietary products on the market containing small amounts of saturated fatty acids. The invention opens up for possibilities to incorporated the fatty acid composition according to the invention in a new or already existing dietary product. In a preferred embodiment of the invention an fish oil is incorporated in a dietary product. Thus, this may be a faster way to reach the market with a dietary product, which product has the aim of supporting, controlling and/or trigger body weight reduction.

Moreover, obesity, having an excessive amount of body fat, is herein defined as a body mass index over 30, wherever overweight is defined as a body mass index exceeding 25. Obesity also includes visceral or general obesity that is due to genetic predisposition, sometimes described as the thrifty genotype. Obesity caused by life cycle and environment, such as diets with high fat content or a high calorie content, or lack of exercise, can also be treated as described herein. As used herein the term "treatment" means both treatment having a curving or alleviating purpose and the treatment of obesity or an overweight condition can be made either acutely or chronically. By chronically treatment is meant treatment that continues for more than some weeks or years. Moreover, the present invention also includes

preventing body weight gain by administering a fatty acid composition according to the invention.

Brief description of the drawings

In the studies and examples below reference is made to the accompanying drawings, where all figures concern studies performed on mice. The studies were preformed in order to demonstrate that a treatment with a fatty acid composition comprising at least one of EPA and DHA or any combinations thereof, reduces body weight. Herein reference is made to the accompanying drawings, on which:

Fig 1A shows the composition of the semisyntetic high-fat diets (20 % w/w fat) containing flaxseed oil with (Ln+FO) respectively without EPAX 2050TG (Ln) given to the different groups of mice's. Figure 1B shows the total body weight after one month of treatment with diets containing flaxseed oil with (Ln+FO) respectively without EPAX 2050TG (Ln) and diets containing lard with (L+FO) respectively without EPAX 2050TG (L).

Figure 2A shows the composition of semi synthetic high-fat diets (20% w/w fat) containing flaxseed oil (Ln), flaxseed oil with a higher dose of EPAX2050TG (Ln+FO) and flaxseed oil with a low dose of EPAX2050TG (Ln+FO Low), given to the different groups of mice. Figure 2B shows the total body weight after two months of treatment.

Figure 3A and 3B show the composition (in % w/w) of semi synthetic high fat (20% fat) diets containing flaxseed oil (Ln), corn oil (K), EPAX 1050TG (high in DHA) (D), EPAX 4510TG (high in EPA) (E), corn oil + EPAX 1050TG (K+D), and corn oil + EPAX 4510 (K+E), respectively the composition (in % of total energy content of the diet) of standard diet (ST) and

semisyntetic diet, given to the different groups of mice's. Figure 3C illustrates the food consumption per day and animal during 8 weeks of treatment. Figure 3D shows the total body weight after two months of treatment compared to the control group (ST).

Description of preferred embodiments

A number of preferred embodiments of the invention, were performed in order to demonstrate that treatment with fatty acid compositions, comprising at least one of EPA and DHA or any combinations thereof, reduces body weight.

In a first preferred embodiment, the effects of an omega-3 fatty acid composition containing about 20% EPA and 50% DHA (weight ratio), on body weight was studied.

In a second preferred embodiment, the effect of the dose of an omega-3 fatty acid composition, rich in DHA, (herein represented as a fatty acid composition comprising about 20% EPA and 50% DHA) in relation to body weight reduction was studied.

Finally, in a third embodiment of the invention, potential differences in effects between a DHA-enriched omega-3 product, an EPA-product and plant oils containing omega-6 fatty acids, were studied.

Examples

Experiments performed on mice:

Three different experiments were performed on mice to investigate various treatments for reducing body weight. In each of the studies adult male mice (C57BL/6J mouse) were randomly assigned different types of semi synthetic

high-fat (20% fat) diets where the fat components in respectively study was modified.

Study 1: weight reduction

In the first study, the effects of an omega-3 fatty acid composition containing EPA and DHA on the body weight were studied. A mixture containing 20% EPA and 50% DHA was used. Groups (n=7) of adult male mice (C57BL/6J mouse) fed standard feeding diet (4% fat), were randomly assigned one of four different types of semi synthetic high-fat (20% fat) diets where the fat component was: Group1) Lard (L), Group 2) Lard plus EPAX2050TG (L+FO: EPAX 2050TG formed 44 % w/w of total lipid content), Group 3) Flaxseed oil (18:3n-3 forms about 50% of total lipids; Ln) and Group 4) Flaxseed plus EPAX2050TG (Ln+FO; EPAX 2050TG formed 44 % w/w of total lipid content). Note that FO herein means various EPA and DHA concentrates (EPAX....TG) used in these studies. The animals were fed the different diets mentioned above during 1 month and the composition of the feeding containing flaxseed oil with (Ln+FO) or without EPAX2050TG (Ln) is shown in figure 1A. After the study, the total body weight was reduced in Group 2 (L + FO) vs. Group 1 (L); and Group 4 (Ln + FO) vs. Group 3 (Ln), and the difference was statistically significant in Group 4 vs. 3, as evident from figure 1B. The body weights of mice before treatment were similar in all the groups. The mice's given flaxseed oil plus EPAX2050TG had decreased by about 10% in body weight compared to the mice's only given flaxseed oil.

This study shows that treatment with a fatty acid composition containing EPA and DHA, wherein the amount of DHA ≥ EPA, leads to weight reduction.

Study 2: weight reduction

In the second study the effect of the dose of an omega-3 fatty acid composition comprising a combination of EPA and DHA (20% EPA and 50% DHA) in relation to reduction on body weight was studied. Groups (n=7) of adult male mice by standard chow diet (4% fat), were randomly assigned one of three different semi synthetic high-fat (20% fat), for two months. In this experiment group 1) was given Flaxseed oil (Ln), Group 2) Flaxseed oil plus a higher dose of EPAX2050TG (Ln+FO; EPAX2050TG formed 44 % w/w of total lipid content), and Group 3) Flaxseed oil plus a lower dose of EPAX2050TG (Ln+FO Low; EPAX 2050TG formed 15 % w/w of total lipid content), as the fat component herein. The composition of the diets containing only flaxseed oil (Ln) and flaxseed oil with a higher (Ln+FO) respectively a lower (Ln+FO Low) dose of EPAX2050TG is shown in figure 2A. At the end of the study the total body weight was reduced only in group 2, the group given flaxseed oil with a higher dose of EPAX2050TG, as evident from figure 2B.

The results of the second study are consistent with the first one, with weight reduction in the group given a fatty acid composition wherein the weight ratio of DHA ≥ EPA. Moreover, the results from the present study also shows that administration of a fatty acid composition rich in DHA in very low doses did not resulting significant decrease of body weight in rats fed a high fat diet.

Study 3: weight reduction

In this study potential differences in effects between a DHA-enriched omega-3 product (herein presented as a fatty acid composition comprising 10% EPA and 50% DHA (EPAX2050TG concentrate), an EPA product (rich in EPA, herein presented as a fatty acid composition comprising 45% EPA and 10% DHA; EPAX4510TG) and plant oils containing omega-6 fatty acids, were studied. Groups (n=7) of adult male mice (C57BL/6J mouse), fed standard chow diet (4% fat), were randomly assigned one of six different types of semisynthetic high-fat (20% fat) diets where the fat component was: group 1) Flaxseed oil (plant omega-3) (Ln), group 2) Corn oil (plant omega-6) (K), group 3) EPAX 1050 (high in DHA) (D), group 4) EPAX 4510TG (high in EPA) (E), group 5) Corn oil + EPAX 1050TG (K+D), and group 6) Corn oil + EPAX 4510TG (K+E). One control group maintained on standard diet (-ST) was also included. The animals were fed the different diets during 2 months. The composition of diets are shown in figures 3A and 3B. As can be seen in figure 3C, the food consumption was about 70 KJ per day and animal during the 8 weeks of treatment. The results in figure 3D show that treatment with a fatty acid composition containing at least EPA and DHA or combinations thereof leads to weight reduction. Weight reduction has been obtained in animals fed EPAX 1050TG (a fatty acid composition rich in DHA) or EPAX 4510TG (a fatty acid composition rich in EPA) in addition (44% of total fat content formed by the product) to corn oil. However, the effect of EPAX 1050TG (high in DHA) was stronger compared with EPAXTG 4510. Moreover, the body weights of the mice fed corn oil plus EPAX 1050TG (high in DHA) had decreased by about 15% in weight. The animals do not tolerate high-fat (20%)

semisynthetic diet containing only EPAX 1050TG (high in DHA) as the only lipid constituent. Only 1 out of 7 mice fed EPAX 1050TG survived longer than 4 weeks on the diet. The mice's got to slimy. All of the rats fed only EPAX 4510TG containing diet survived but looked unhealthy.

The results of the third study shows that the weight lowering effect of a fatty acid composition comprising about 10% EPA and 50% DHA (a fatty acid composition rich in DHA), was stronger compared to a fatty acid composition comprising about 45% EPA and 10% DHA (rich in EPA). Furthermore, weight reduction due to corn oil was similar to the reduction due to a fatty acid composition comprising about 20% EPA and 50% DHA in flaxseed oil (in the 1st and the 2nd experiment) and stronger than the reduction due to a fatty acid composition comprising about 20% EPA and 50% DHA in lard (in the 1st experiment). Once more above states a best mode using a product rich in DHA, preferably DHA ≥ EPA. These results also suggest a specific weight-lowering effect of an omega-3 product of marine origin as compared with plant oils (both omega-3 and omega-6) and saturated fats (lard).

Doses of the fatty acid composition

Concerning the dose, the results from mice may be extrapolated to humans, as far as the relative content of the fatty acid composition according to the invention, for instance an fatty acid composition containing EPA and DHA or any combinations thereof, in the diet is concerned. In the studies before a semi-synthetic diet containing 20% (w/w) fat was used, and effect on weight reduction was observed when at least about 28% of the lipid content was replaced by a fatty acid composition

according to the invention (by the addition of a fatty acid composition according to the invention), while there was almost none effect on weight reduction when a fatty acid composition according to the invention formed 9 % of the lipid content of the diet. These diets provided 40% of the energy from lipids.

The relative content of the fatty acid composition according to the invention with respect to the total lipid content (in the diet) may be more important than the absolute intake, as far as the effect on weight reduction is concerned. Therefore, one embodiment of the invention is to replace at least 1/3 of the total lipid in the diet by a fatty acid composition comprising at least one of DHA and EPA or any combinations thereof, according to the invention. Please se some relevant fictive scenarios presented below.

1. A human consuming 5000 kcal/day with 30% of calories from fat. In this case 28% of 166g of total lipid intake may be replaced by the fatty acid composition according to the invention, saying 46 g fatty acid composition/day.
2. A human on a low calorie diet, 1000 kcal/day with 18% calories from fat. In order to replace 28% of 20 g of the a total lipid intake by a fatty acid composition according to the invention, the actual person need 5,6 g fatty acid composition/day.

By assume synergism between calorie restriction and the fatty acid composition according to the invention in the effect on weight reduction, also lower concentration of the fatty acid composition in dietary lipids show effect on weight reduction.

In another preferred embodiment of the invention at least 15% of the lipid content in the diet is replaced by

the fatty acid composition according to the invention. This means about 3 g of the fatty acid composition per day, in a very low calorie diet of 1000kcal/day with 18 % calories from fat.

In a preferred embodiment of the invention, the treatment of obesity or overweight conditions, or for the purpose of weight control according to the invention, is carried out together with a reduced intake of calories for a human or an animal. Preferably, the dietary regime of calorie reduction is combined with physical activity.

In another preferred embodiment of the invention, said reduced intake of calories is reduced to at least 800 kcal (2520 KJ per day) or less, for a short and drastic treatment of obese patients (adult persons). In a more preferred embodiment said fatty acid composition comprising at least one of EPA and DHA or any combinations thereof is administered in a daily dosage from (corresponding to) 10 up to 40 % of the total lipid content of a daily diet for a human. Moreover, to achieve a improved result the lipid content of the diet may be lowered to at least 15 % of its energy content. The fatty acid composition according to the invention is preferably administered daily, divided in dosage, for periods up to 1-5 years.

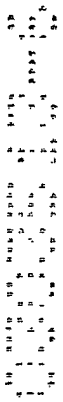
On the other hand, the dosage of the fatty acid composition according to the invention may also be related to the amount of omega-3 fatty acids consumed by for instance Eskymo's or similar native people. Therefore, in an another embodiment of the invention said fatty acid composition comprising at least one of EPA and DHA or any combinations thereof, is administered in an amount providing a daily dosage of 1 g to 15 g of said

fatty acid composition. More preferred in an amount of 1 to 10 g, and most preferred between 2 and 6 g per day.

Discussion

The results shows that a fatty acid composition comprising at least one of EPA and DHA or any combinations thereof, reduces body weight. The weight lowering effect of a product according to the invention that is rich in DHA is stronger compared to a product containing more EPA than DHA. Moreover, preferably a specific weight-lowering effect is achieved of a fatty acid composition according to the invention of marine origin. Further, based on the results, calculations of doses and commercial value, the use of the fatty acid composition according to the present invention preferably may go hand-in-hand with a dietary regimen of calorie reduction. It is also obvious to expect the same weight lowering effect on both humans and animals by administering the fatty acid composition according to the invention.

The invention shall not be limited to the shown embodiments and examples.



Claims

1. Use of a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for the production of a medicinal product for controlling body weight reduction, and for treatment of obesity or an overweight condition.

2. Use according to claim 1, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1.

3. Use according to claim 1, wherein the combination of EPA and DHA are present in the composition in an EPA:DHA ratio from 1:1 to 1:8, preferably in an EPA:DHA ratio from 1:1 to 1:6.

4. Use according to claim 1, wherein the fatty acids in the composition is presented in at least one of esterified form, ethyl ester form, salt form and free acid form, or any combinations thereof.

5. Use according to claim 1, wherein at lest one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins or combinations thereof.

6. Use according to claim 1, wherein at least a part of the EPA and/or DHA is produced from a marine oil, preferably a fish oil.

7. Use according to claim 1, wherein the fatty acid composition is produced from a marine oil.

8. Use according to claim 1, wherein the fatty acid composition is comprised of a combination of EPA and DHA in triglyceride form.

9. Use according to claim 1, wherein the fatty acid composition is administered orally to a human or an animal.

10. Use according to claim 9, wherein the treatment is carried out together with a reduced intake of calories for a human or an animal.

11. Use according to claim , wherein said fatty acid composition is administered in a daily dosage in the interval 10-40 % of the total lipid content of a daily diet for a human or an animal.

12. Use according to claim 1, wherein said fatty acid composition is administered in an amount providing a daily dosage of 1 g to 15 g of said fatty acid composition, preferably between 2 and 6 g for a human.

13. A method for treatment of obesity, an overweight condition or for controlling body weight reduction, wherein an effective amount of a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, is administered to a human or an animal.

14. A method according to claim 13, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1.

15. A method according to claim 13, wherein the combination of EPA and DHA are present in the composition in an EPA:DHA ratio from about 1:1 to 1:8, preferably in an EPA:DHA ratio from 1:1 to 1:6.

16. A method according to claim 13, wherein the fatty acids in the composition is presented in at least one of esterified form, ethyl ester form, salt form and free acid form, or any combinations thereof.

17. A method according to claim 13, wherein the fatty acid composition is comprised of a combination of EPA and DHA in triglyceride form.

18. A method according to claim 13, wherein at lest one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins.

19. A method according to claim 13, wherein at least a part of the EPA and/or DHA is produced from a marine oil, preferably a fish oil.

20. A method according to claim 13, wherein the composition is administered orally to a human or an animal.

21. A method according to claim 13, wherein the treatment is carried out together with a reduced intake of calories for the human or an animal.

22. A method according to claim 13, wherein said fatty acid composition is administered in a daily dosage that corresponds to at least 10 % of the total lipid content of a daily diet for a human or an animal.

23. Use of a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for the production of a food stuff or food supplement for controlling and supporting body reduction.

24. Use according to claim 23, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1.

25. Use according to claim 23, wherein the combination of EPA and DHA are present in the composition in an EPA:DHA ratio from about 1:1 to 1:8, preferably in an EPA:DHA ratio from 1:1 to 1:6.

26. Use according to claim 23, wherein the fatty acids in the composition is presented in at least one of esterified form, triglyceride form, ethyl ester form, salt form and free acid form, or any combinations thereof.

27. Use according to claim 23, wherein the fatty acid composition is comprised of a combination of EPA and DHA presented in triglyceride form.

28. Use according to claim 23, wherein at least one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins or combinations thereof.

29. Use according to claim 23, wherein the at least a part of the EPA and/or DHA is produced from a marine oil, preferably a fish oil.

30. Use according to claim 23, wherein the fatty acid composition is produced from a marine oil.

31. Use according to claim 23, wherein the composition is administered orally to a human or an animal.

32. Use according to claim 31, wherein the control of body weight and fat reduction is carried out together with a reduced intake of calories for a human or an animal.

33. Use according to claim 23, wherein said fatty acid composition is administered in a daily dosage that corresponds to at least 10 % of the total lipid content of a daily diet for a human or an animal.

34. Use according to claim 23, wherein the food stuff or food supplement is in form of a gelatine capsule, which capsule is flavoured.

35. Use according to claim 23, wherein said fatty acid composition comprising DHA or a combination of EPA and DHA is administered in an amount providing a daily dosage of 1 g to 15 g of said fatty acid composition, preferably between 2 and 6 g to a human.

36. A dietary product containing a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling body weight reduction.

37. A dietary product according to claim 36, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1.

38. A dietary product according to claim 36, wherein the dietary product is a weight-watching product or a slimming product.

39. A dietary product according to claim 36, wherein the combination of EPA and DHA are present in the composition in an EPA:DHA ratio from about 1:1 to 1:8, preferably in an EPA:DHA ratio from 1:1 to 1:6.

40. Use according to claim 36, wherein at least one of EPA and DHA is obtained from at least one of vegetable, microbial and animal origins or combinations thereof.

41. A dietary product according to claim 36, wherein the fatty acid composition is produced from a marine oil, preferably a fish oil.

42. A dietary product according to claim 36, wherein intake of the dietary product is combined with a reduced intake of calories for a human and/or together with physical activity.

43. A method according to claim 36, wherein said fatty acid composition is administered in a daily dosage that corresponds to at least 10 % of the total lipid content of a daily diet for a human or an animal.

44. Use of a fatty acid composition comprising comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, in the manufacture of a dietary product for controlling and supporting weight reduction in a human.

45. Use according to claim 44, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or greater than 1.

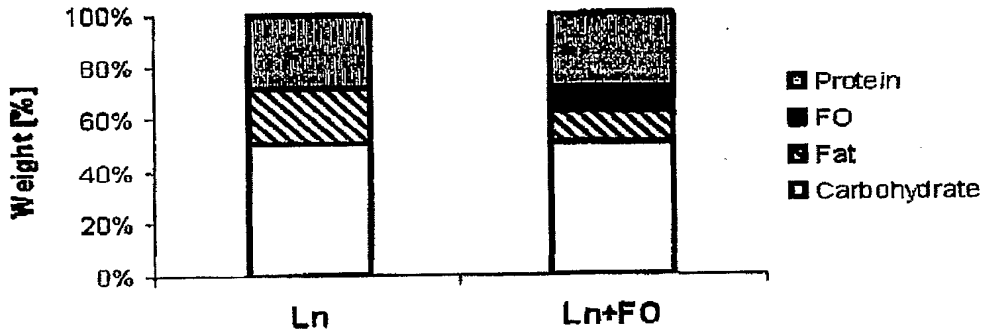
46. A method for supplementing a dietary product comprising the step of
adding a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, to the supplement

product for controlling and supporting weight reduction in a human.

47. A method according to claim 46, wherein the weight ratio of EPA:DHA in the fatty acid composition is 1:X, where X is equal or lager than 1.

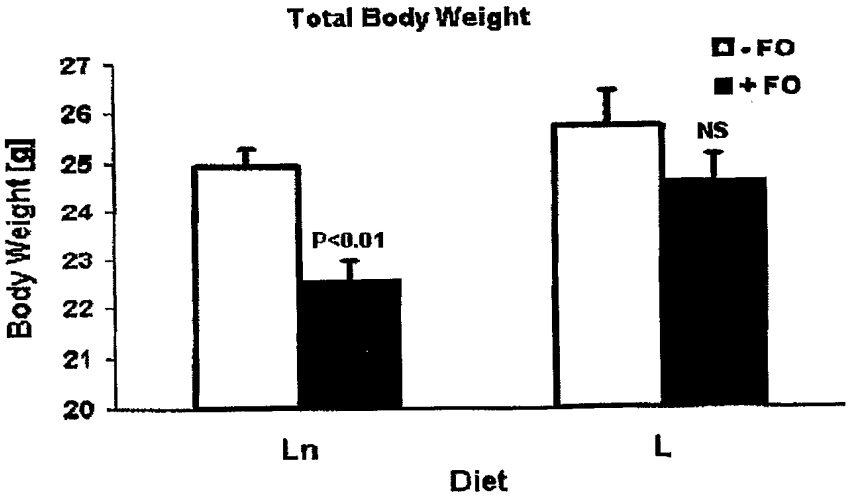
Abstract

This invention relates to a method for treatment of obesity, an overweight condition or for controlling body weight reduction, wherein an effective amount of a fatty acid composition comprising at least on of (all-Z omega-3)-5,8,11,14,17-eicosapentaenoic acid (EPA) and (all-Z omega-3)-4,7,10,13,16,19-docosahexaenoic acid (DHA) or any combinations thereof, is administered to a human or an animal. The present invention also relates to use of the fatty acid composition above for manufacture of a medicinal product for controlling body weight reduction, and for treatment of obesity or an overweight condition. Moreover, the present invention also relates to use of a fatty acid composition comprising at least on of EPA and DHA or any combinations thereof, for the manufacture of a food stuff or food supplement for controlling and supporting body weight reduction. Additionally, the present invention also includes a dietary product containing a fatty acid composition comprising at least on of EPA and DHA or any combinations thereof, for non-medical treatment of obesity, an overweight condition and/or for supporting and controlling body weight reduction. Finally, the present invention relates to a method for supplementing a dietary product with a fatty acid composition mentioned above.



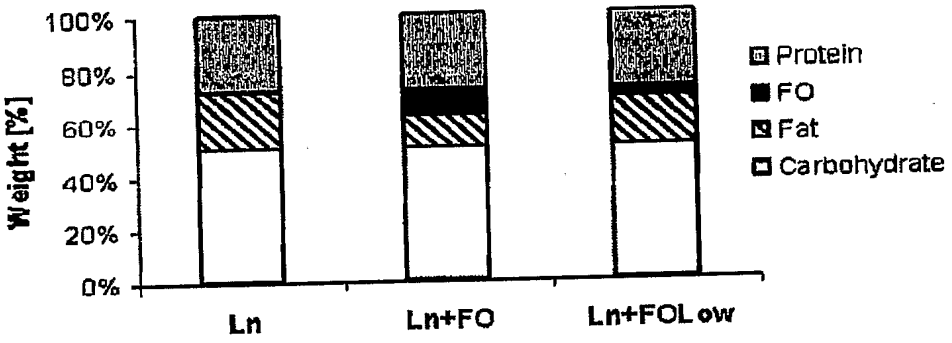
Composition of the semisyntetic high-fat diets (20 % w/w fat) containing flaxseed oil (Ln) and flaxseed oil with EPAX 2050TG; FO (Ln+FO)

Fig. 1A



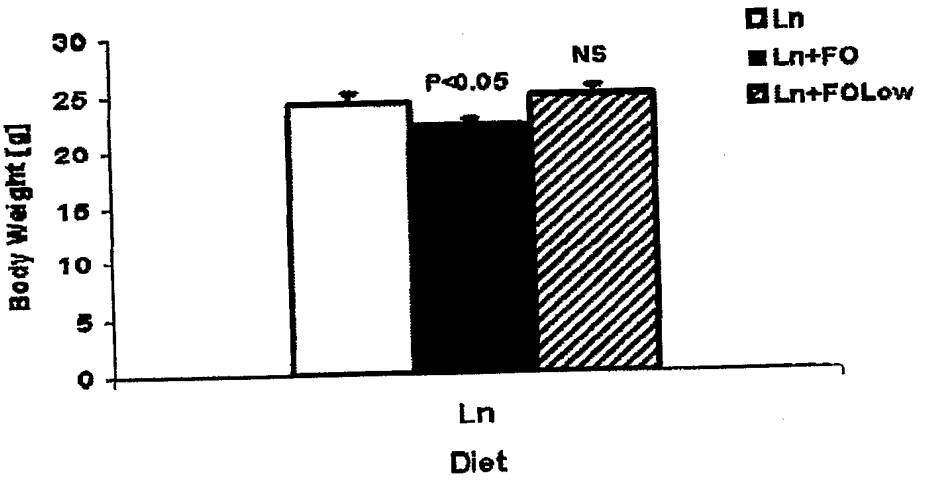
Total body weight after one month of treatment. Lard (L), Lard plus EPAX2050TG (L+FO), Flaxseed oil (Ln) and Flaxseed plus EPAX2050TG (Ln+FO)

Fig. 1B



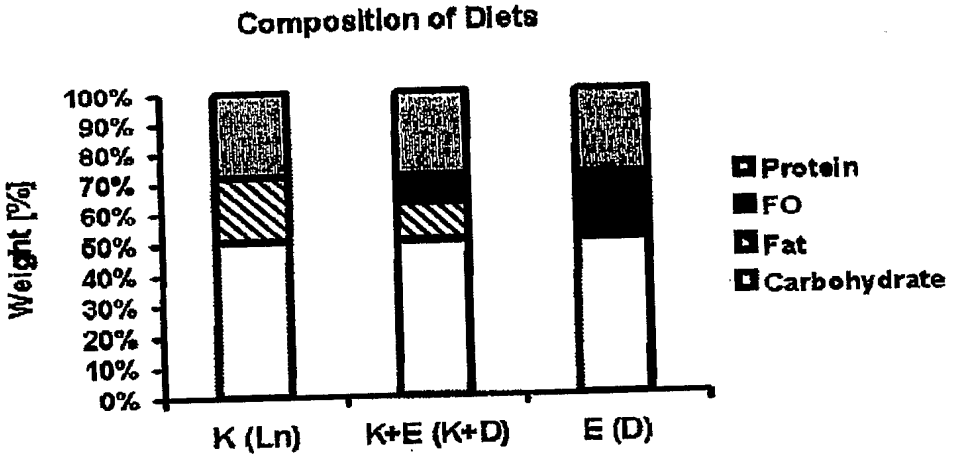
Composition of semisynthetic high-fat diets (20 % w/w fat) containing flaxseed oil (Ln), flaxseed oil with a higher dose of EPAX2050TG (Ln+FO) and flaxseed oil with a lower dose of EPAX2050TG (Ln+FO Low)

Fig. 2A



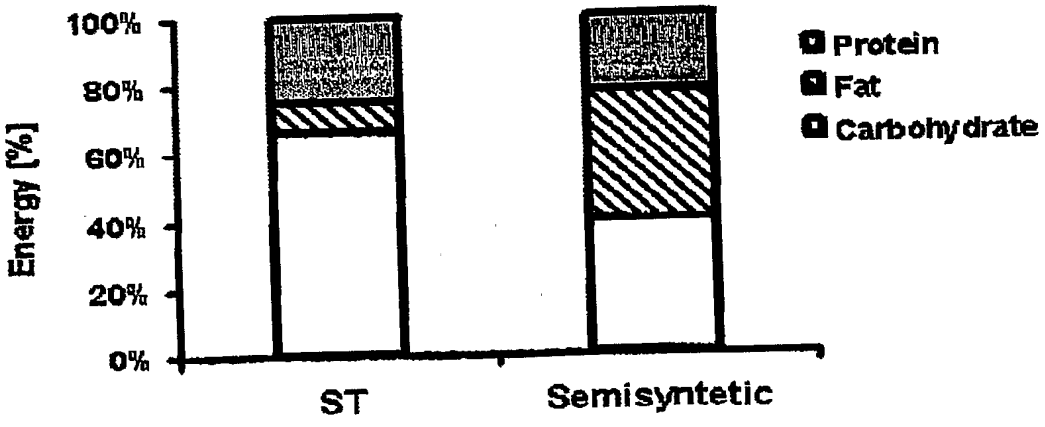
Total body weight after two months of treatment. Flaxseed oil (Ln), Flaxseed oil plus a higher dose of EPAX2050TG (Ln+FO) and Flaxseed oil plus a lower dose of EPAX2050TG (Ln+FO Low).

Fig. 2B



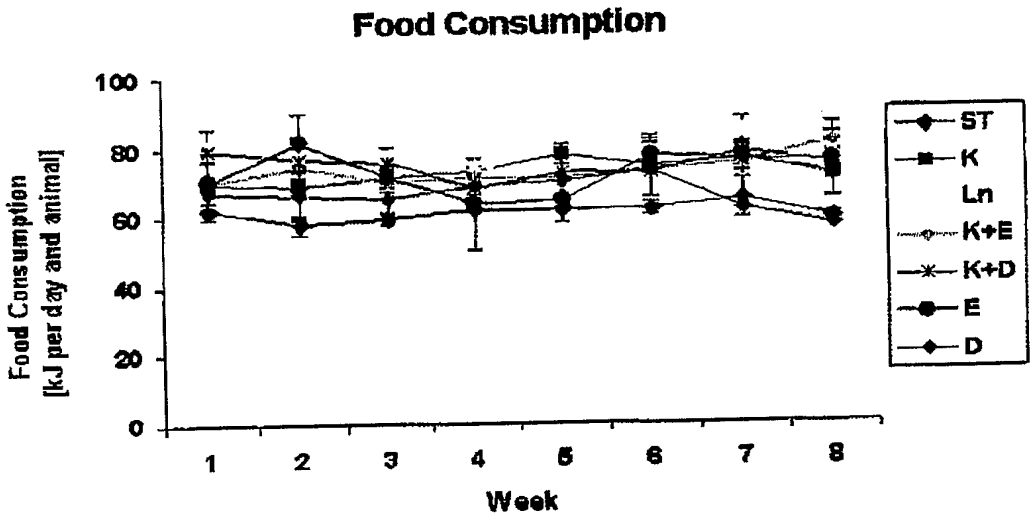
Composition of semi synthetic high-fat (20 % w/w fat) diets containing Flaxseed oil (Ln), Corn oil (K), EPAX 1050TG (high in DHA) (D), EPAX 4510TG (high in EPA) (E), Corn oil + EPAX 1050TG (K+D), and Corn oil + EPAX 4510TG (K+E).

Fig. 3A



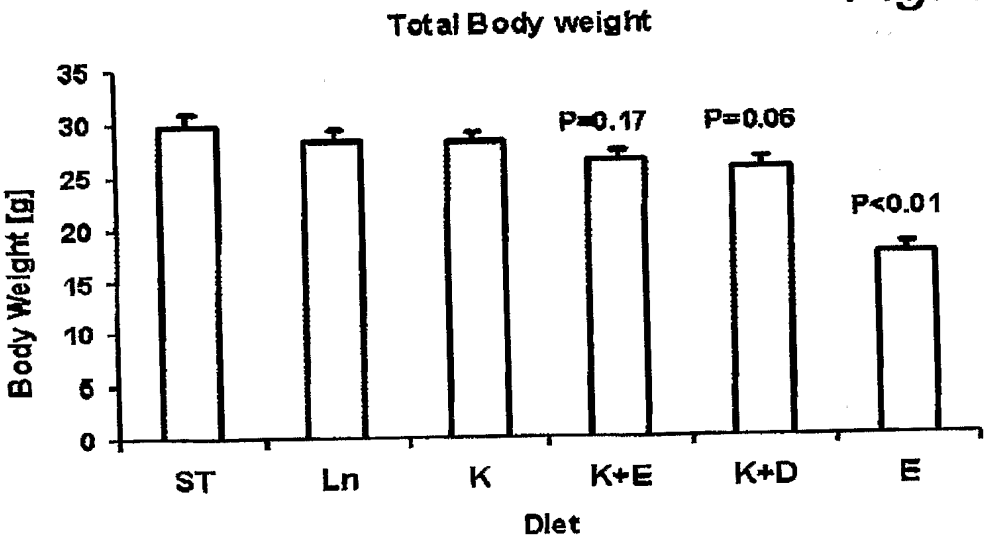
Composition of standard diet (ST) and semisyntetic diet.

Fig. 3B



Food consumption per day and animal during 8 weeks.

Fig. 3C



Total body weight after two months of treatment compared to a control group (ST). Flaxseed oil (Ln), Corn oil (K), EPAX 1050TG (high in DHA) (D), EPAX 4510TG (E), Corn oil + EPAX 1050TG (K+D), and Corn oil + EPAX 4510TG (K+E).

Fig. 3D